

DOE-FUNDED STUDY RELEASES DATA ON RADIATION DOSE MODEL FOR POPULATION NEAR HANFORD NUCLEAR SITE

Phase I of the Hanford Environmental Dose Reconstruction Project (HEDR) has been completed, and investigators released preliminary data in July. The dose study is funded by the Department of Energy (DOE) and conducted by Battelle Memorial Institute's Pacific Northwest Laboratories under the direction of a Technical Steering Panel (TSP), which is made up of scientists representing the states of Washington and Oregon as well as Native American representatives.

The preliminary dose estimates show that while the majority of the test population was probably not exposed to levels of radiation exceeding amounts normally received as background radiation, a small percentage of the population was probably exposed to extremely high levels of radiation — higher than an average individual would receive in a lifetime from background radiation. Those predicted to have the highest exposure were infants who received the bulk of their exposure through milk from local dairy cows, whose milk contained iodine-131 (^{131}I).

The Hanford Site, which opened in 1944, processed plutonium for nuclear weapons for over forty years. The plant released radionuclides into the air and water during that time, exposing the population near the plant to radiation (see Figure 1). The airborne radioactive emissions were heaviest during Hanford's early years of operation before filters were put on the plant's smokestacks. Iodine-131 was released through the smokestacks after fuel from the reactors was dissolved in acid to extract plutonium.

During Phase I of the HEDR, scientists elected to study the release of ^{131}I through the air exposure pathway from 1944 through 1947. This time period was picked because about 90% of the total ^{131}I releases at the plant occurred at this time and because ^{131}I accounted for most of the airborne radioactivity released during those years. The HEDR Draft Report states that "more than 80% of the total dose to people in the downwind portion of the Phase I study area from 1944 to the present is estimated to have come from exposure to iodine-131 released to the air."

The milk exposure pathway was the most important contributor to estimated doses received through the air exposure pathway. The ^{131}I was released into the air and absorbed by the grass in downwind communities. The grass was eaten by dairy cows, and the ^{131}I became concentrated in the cows' milk. The dose model estimates that 50% of the Phase I population (135,000 people) may have received a dose to the thyroid higher than 1.7 Rad (0.017 Gy) through the milk exposure pathway, while 5% of the population (13,500 people) may have received a dose higher than 33 Rad (0.33 Gy). The model further estimates that 1.5%-2.0% of the population (4,500-5,400 people) may have received doses higher than 100 Rad (1 Gy), while about 0.004% of the population (11 people) may have received doses higher than 2,530 Rad (25.3 Gy).

Based on these dose estimates, about 5% of this population (13,500 people) may have received a milk exposure pathway dose greater than the cumulative amount of background radiation received by an average indi-

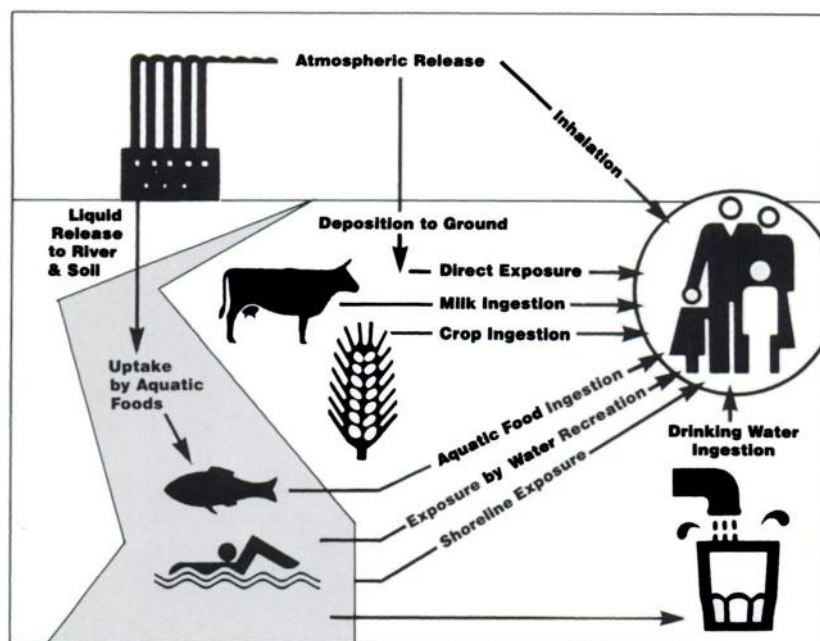
vidual over this time period, and about 1% of this population (2,700 people) may have received a dose greater than an average individual's lifetime dose of background radiation.

During Phase I, scientists also estimated radiation doses received through the water exposure pathway from 1964 through 1966. They selected this time period because the best river monitoring data were available then, and all the reactors were operating and at their highest power levels in 1964.

During the plant's operation, water from the Columbia River was pumped through Hanford's eight single-pass reactors to cool them. The resulting liquid radioactive waste was held in retention basins for several hours and then released into the Columbia River. Eight radionuclides accounted for the bulk of the radiation dose received through the water exposure pathway: phosphorous-32, neptunium-239, zinc-65, arsenic-76, manganese-56, copper-64, sodium-24, and chromium-51, and the researchers decided to concentrate on these radionuclides.

The water exposure pathway study was limited to the portion of the river known as the Hanford Reach, and the communities studied were downstream from the Hanford Site and were exposed to radiation by drinking water or eating fish from the river or by swimming in the river. The HEDR report concludes that "the highest doses were likely received by people who consumed large amounts of fresh fish (more than 20 fish meals per year) caught from the Columbia River above Richland."

The researchers conclude that it is
(continued on page 24A)



(Figure 1. Radionuclide Exposure Pathways
Adapted from: Draft Report of the Hanford Estimated Dose Reconstruction Project)

Hanford

(continued from page 22A)

unlikely that anyone living in the study area received a cumulative river exposure dose for 1964 through 1966 higher than the individual yearly background radiation average dose.

The TSP stresses that the "objectives of the HEDR Project do not include estimating risk or extrapolating to health effects that might have resulted from the radiation exposures." John E. Till, PhD, an environmental dosimetry expert who chairs the TSP, explained that "the objective of Phase I was to develop and test a methodology for making dose estimates, not the delivery of dose estimates themselves." However, the release of the preliminary Phase I data has resulted in extensive media coverage of the data, with concomitant extrapolations of possible health effects.

Although the HEDR makes no attempt to interpret these data, the medical implications are of obvious interest to medical professionals who deal with radiation. David V. Becker, MD, director of nuclear medicine at New

York Hospital-Cornell Medical Center in New York City, says that patients in the 1950s and 1960s were routinely given diagnostic doses of 75 Rad (0.75 Gy) of ^{131}I with no ill effects. A study by Swedish epidemiologist Lars E. Holm, M.D., and his colleagues in the 1980s confirmed that diagnostic doses of ^{131}I of 50-100 Rad (0.5-1 Gy) caused no ill effects in the patients (1).

Bertrand Brill, MD, director of nuclear medicine research at the University of Massachusetts Medical Center in Worcester, Massachusetts, and Chairman of The Society of Nuclear Medicine Committee on the Radiobiological Effects of Ionizing Radiation, says that although some people may have received excessive doses of radioactive iodine, especially in the 1940s, the identification of the particular children among the 10 to 20 who could have received extremely high doses to their thyroids (over 2,500 Rad [25 Gy]) will be very difficult if not impossible to achieve. Further, given the small number of children who received large doses, the uncertainties in dose, and the low fre-

quency of thyroid cancer expected, the results are unlikely to be positive or to contribute new knowledge concerning the hazards of ^{131}I exposures. Dr. Brill notes that since the potential dose was based on estimates of how far downwind from the releases the children were, whether they drank milk from local cows, and how much they drank, there could be wide variations between the suppositions the researchers chose to make and the actual doses received by these children.

Eugene L. Saenger, MD, Professor Emeritus and Director Emeritus of the Eugene L. Saenger Isotope Laboratory of the University of Cincinnati Medical Center in Ohio, comments on the tenuousness of the assumptions the researchers used to set up their model. He says that in order to use the model effectively, individuals must be able to accurately assess their milk consumption patterns during their infancy and childhood. Dr. Saenger points out that it is not realistic to expect people to have this type of information 40 years later. "How many people," he asks, "can remember whether they drank any cow's milk, how many glasses of milk they drank on a daily basis, or whether they drank milk from a family cow that ate pasture grass? In practical terms, most people can't remember what they ate or drank as children. So how are the potentially exposed individuals reading the report supposed to apply it?"

Dr. Saenger questions the use of the concept of the effective dose equivalence (EDE) in the study. He states that the term is used to homogenize varying dose levels from uneven concentrations and doses of different radionuclides into a single number. "The relevance of such a number in 1988 to events in the 1940s is unclear and in no way indicates whether the public was threatened by releases of radioiodine."

Dr. Saenger also commented on the lack of cancer risk estimates in the HEDR report. He notes that once the

dose estimates have been constructed, the logical next step is to apply those doses to one of the well-known published tables that correlate dose received with risk of cancer, such as the risk estimates published by the National Council on Radiation Protection and Measurements (2). "My principal concern with the information released to the public is that it provides no perspective of possible excess cancer risk from the presumed radioiodine release. Nor was there an estimate of the value versus the natural incidence of thyroid cancer that occurs in the absence of ^{131}I ."

Dr. Till explains that at the time the HEDR was set up, the entities involved knew that a separate epidemiological study had been recommended and the decision was made before the HEDR began to limit the study to dose estimates. Dr. Till supports that decision, noting that if the HEDR had attempted to give a precise risk estimate, they might have undermined the epidemiological study by forcing it to accept the stated risk estimate even if it correlated very poorly with the number of cancer cases actually found. Dr. Till states that "studies of risk are quite site-specific. There are estimates of uncertainty associated with the risk factors, and I would feel uncomfortable using a single risk estimate derived from other studies."

Many consumer groups and state organizations have emphasized the need to conduct epidemiological studies of the affected populations based on the HEDR data. Such a study is now being undertaken by the Centers for Disease Control (CDC) through the Fred Hutchinson Cancer Research Center in Seattle, Washington. The Research Center will study the data to see if there is a correlation between thyroid disease and estimated doses of ^{131}I to the population that lived near the Hanford Site in the 1940s and 1950s.

The Hanford Health Effects Review Panel, convened by the CDC at the

urging of the Washington State Nuclear Waste Board and the Indian Health Service, recommended the Hanford Thyroid Disease study in 1986, and Congress appropriated money for the study in 1988. The researchers are currently engaged in a pilot study, in which they randomly select, interview, and study several hundred people in the target population. The main study will begin in 1991 and may be expanded to a larger group. Results are expected by 1993.

Dr. Brill says that the Thyroid Disease Study will have great difficulty showing a correlation between doses received and observed effects because it will be impossible for researchers to attribute a case of thyroid cancer to a known radiation dose. "The researchers will be relying on the dose estimate model, which only gives potential doses extrapolated from many assumptions, and will have to attempt to separate thyroid cases due to the Hanford releases from thyroid cases that would normally have occurred in that population with no releases — a difficult if not impossible task." Dr. Brill notes that all cases of thyroid cancer due to the Hanford releases will have manifested themselves by now, as 40 years is sufficient time for the full expression of thyroid pathology.

Dr. Becker concurs that the Hanford Thyroid Study will not be able to calculate actual doses received by individuals. However, he sees the study as warranted not on a scientific basis but rather on a humanitarian level. "The people who live near Hanford want to know what happened to them. Although the potential doses received by most of the population were not high enough to cause any damage, people don't believe this. The problem is one of perception. And the Hanford Thyroid Study can go a long way toward relieving peoples' fears."

Phase I of the HEDR was devoted to collecting and evaluating historical data; developing a model to measure

radiation doses received during a limited time period, in a limited geographical area, from a limited number of radionuclides; and testing the model against historical data. Phases II and III will evaluate the results of the Phase I model, refine the model through sensitivity analyses, expand the scope of the model, and attempt to reduce uncertainties in the model. In Phase IV, researchers will calculate final estimated doses.

During Phase II of the HEDR, as scientists refine their dose estimate model, the new estimates will have a higher probability of being close to the radiation doses actually received. Dr. Till says that the TSP is not satisfied with the air model and that considerable work will be done on it during Phase II. Other parts of Phase II will include the following: the geographic area covered may be increased to include a few counties that can serve as controls in the Hanford Thyroid Study; the collection of river data will be expanded to cover the Columbia River from the Hanford Site all the way to the Pacific Ocean; and researchers will work with eight local tribes to complete the collection of dietary data for Native Americans. Since many Native Americans ate fish daily during the time period studied, their exposure through fish will be much greater than that calculated for the rest of the local population. Phase II planning started in October and the results should be available by early 1992.

Three Mile Island Public Health Fund (TMIF) is also studying the Hanford workers and will conduct additional epidemiologic studies on other DOE nuclear facilities over the next few years.

Joan Hiam

References

1. Holm LE. Thyroid cancer after diagnostic doses of iodine-131. *J Natl Cancer Inst* 1988; 80:1132-1138.
2. Induction of thyroid cancer by ionizing radiation. National Council on Radiation Protection and Measurements. Report No. 80, 1985.